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THE DROUGHT, FEBRUARY TO APRIL, 1938

The drought of the spring of this year has been acclaimed in the newspaper press as unequalled for over a century. Although it is a little too early to make a detailed study of the drought, there is no doubt at all that over a very wide area the aggregate shortage of rainfall during the three months ending in April was unprecedented within living memory.

Table I shows the general rainfall over the whole of the British Isles for the separate months of February, March and April and for the total period in 1938 and in some previous years of drought, while Table II gives the equivalent figures for England and Wales as this is the area most affected. The percentage of the average rainfall (1881–1915) is also given in these tables.

Looking at the figures in Table II we see that in England and Wales the combined rainfall of February and March, 1938 was distinctly greater than the combined rainfall of those months in 1929; also the combined rainfall of March and April, 1938 was rather greater than the combined rainfall of those months in 1893. The aggregate for the three months, amounting this year to only 2·34 inches or 32 per cent. of the average, is however very much less than that of any similar period since comparable records began in 1870. In carrying the comparison back to earlier years we have also used the table of monthly rainfall percentages given by J. Glasspoole and Miss F. J. Nicholas.(1) From this article, where it is explained that the values for years before 1870 are unavoidably less

(1) General Monthly Rainfall over England and Wales 1727–1931—*British Rainfall*, 1931, p. 299.

precise, we see that noteworthy sequences of three dry months February to April, occurred in 1887, 1875, 1863, 1854, 1834, 1790, 1786, 1785, 1771, 1741, 1740 and 1738. In 1785 the percentage was 44 in February, 17 in March and 22 in April and we may estimate that the total general rainfall over England and Wales for the three months was about 2·1 inch. With this exception no other similar period appears to have given a total lower than that experienced in 1938.

TABLE I. GENERAL RAINFALL OVER THE BRITISH ISLES

Year.	February.		March.		April.		Feb.–April.	
	in.	%	in.	%	in.	%	in.	%
Av. 1881–1915 ...	3·26	100	3·22	100	2·52	100	9·00	100
1893	4·79	147	1·09	34	0·88	35	7·76	86
1921	0·98	30	3·45	107	1·46	58	5·89	65
1929	2·09	64	0·61	19	1·59	63	4·29	48
1938	2·02	62	1·67	52	0·43	16	4·12	45

TABLE II. GENERAL RAINFALL OVER ENGLAND AND WALES

Year.	February.		March.		April.		Feb.–April.	
	in.	%	in.	%	in.	%	in.	%
Av. 1881–1915 ...	2·57	100	2·67	100	2·12	100	7·36	100
1893	4·26	166	0·61	23	0·38	18	5·25	71
1921	0·39	15	1·95	73	1·34	63	3·68	50
1929	1·23	48	0·37	14	1·29	61	2·89	39
1938	1·34	52	0·72	27	0·28	13	2·34	32

Reference to the same table shows that a general rainfall over England and Wales of less than 20 per cent. of the average in April has occurred on only three previous occasions namely in 1817 (16 per cent.), 1893 (18 per cent.) and 1912 (15 per cent.). During the great spring drought of 1893 no rain at all occurred during April over a considerable part of south-east England. Also in April, 1912, no rain occurred in parts of Berkshire and Sussex. During April, 1938, only a few stations recorded no measurable rain ; the main feature was the large area with only a total of about one-tenth of an inch. The small totals were perhaps most remarkable over Ireland where the general rainfall was ·20 inch (or 7 per cent. of the average), the next driest Aprils being those of 1875 and 1921 with 43 and 45 per cent. respectively. Falls of 1 in. or more were restricted to mountainous districts of central and northern Wales,

Derbyshire, the English Lake District and parts of the north and west of Scotland. The month certainly ranks with February, 1891, June, 1925 and February, 1932, as one of the driest ever recorded over the British Isles generally.

The following is a brief summary of the dry periods during the three months under review. The first seven days and the 18th to 23rd of February were dry generally over the whole of England and Wales, while the driest days over Scotland and Ireland were from the 12th to 23rd. The last few days of the month were wet over the whole of the British Isles except at a few individual stations. With the 1st of March the drought began again over England, Wales and south-eastern Scotland, and except for the few days 24th–27th, continued throughout the month. The rest of Scotland experienced a few dry days about the 11th while over Ireland the periods of general dryness were from the 2nd to 7th and from the 10th to 13th. Except for partial breaks on the 2nd and 22nd of April the weather continued dry over England, Wales and south-eastern Scotland throughout the month, the last two days of the month producing showers of rain, hail and sleet over the east coast from Tynemouth to Shoeburyness. The whole of Ireland had very little rain from April 5th, while western and south-western Scotland had dry weather from the 7th, except for a break on the 21st and 22nd. The remaining parts of Scotland also experienced dry weather about the second week in April but it was broken in most parts on the 15th. The days on which no measurable rain fell at any of the representative stations in the *Daily Weather Report* are of interest ; they are as follows :— February 20th, March 12th, April 8th and 10th to 14th. Periods when very little rain fell in all districts were February 17th to 23rd, March 12th to 13th and April 8th to 14th.

The famous spring drought of 1893 did not commence until the beginning of March and persisted until the first few days of July. At North Ockendon, Romford, Essex, only 1·23 in. of rain was recorded on the 128 days from March 2nd to July 7th and at Dungeness in Kent 1·27 in. was measured in the 127 days from February 27th to July 3rd. These were the longest partial droughts observed, but over 100 days of partial drought were also recorded at stations in south-eastern England, and all stations south of a line from Bristol to Boston in Lincolnshire had a partial drought exceeding 75 days. So far this year we find that in the 89 days from February 1st to April 30th, Kew Observatory recorded 0·70 in. of rain, Ross-on-Wye 0·76 in., and South Farnborough 0·79 in. Many stations have recorded about 60 days of partial drought beginning 1st March. Perhaps the best illustration of the severity of the 1893 drought is the example quoted by G. J. Symons in his article in the *Journal of the Royal Agricultural Society*, June, 1893, where he mentions that a station in Brighton recorded two " absolute droughts ", of 30 days and 28 days respectively, which were only separated by one day on which 0·06 in. fell during a

shower of rain, so that the rainfall for the whole of the 59 days was only 0·06 in. Ross-on-Wye has experienced almost a similar period this year, for March was almost entirely dry and April gave rain only on the 2nd and 21st, and in the 61 days from March 1st to April 20th, only 0·06 in. was measured.

Some Notes on the April Anticyclone

Persistent anticyclones always pass through a succession of cycles, and that of April, 1938 was no exception, being rejuvenated four times during the month, through fresh developments in the rear of cold fronts, or occlusions with colder air behind them. These fronts can be traced across the Atlantic and finally crossed the British Isles from north to south, dying out in the process. In the course of the first rejuvenation (April 7th to 9th) a cold wedge of high pressure to north of the old anticyclone developed into a new system of unusual intensity for April. The second and fourth rejuvenations (15th to 16th and 26th to 27th) were both due to a distinct new anticyclone moving eastward on the Atlantic and absorbing the old decaying one. In the third case (24th) the new system amalgamated with the old one, with a rapidly vanishing front moving through the complex central area. In the course of these developments the air in the lower troposphere was renewed three times over the greater part of the anticyclonic area, and on another occasion over at least half of it.

After the evening of April 16th, the air supply over England was continuously drawn from high latitudes, mainly from northern Canada. After reaching the Iceland area it circulated round the anticyclone, and supplied the N.E. current over southern England. The following figures for the upper air temperature for the second half of the month show the result of the cold air supply :—

Pressure ...	900 mb.	800 mb.	700 mb.	600 mb.	500 mb.
	°F.	°F.	°F.	°F.	°F.
Mildenhall Mean temp.	34·4 (−3·6)	21·5 (−6·9)	13·9 (−5·4)	1·9 (−3·7)	−11·7 (−1·7)
Aldergrove Mean temp.	36·2	29·1	22·0	10·0	−5·4

The figures in the brackets are the departures from the averages for the second half of April, deduced from the April and May figures. No averages are available for Aldergrove, but it is clear that from 800 mb. upwards temperature exceeded the normal in that area owing to subsidence. The air over south-east England had also almost certainly subsided, but not sufficiently to overcome its initial coldness. At 900 mb. the deficiency of temperature

had evidently been reduced by heating from below during the long sea track. The natural results of the Mildenhall distribution of upper air temperature over the land were cool mainly cloudy days and clear frosty nights.

The NE. current which crossed southern England continued its circulation round the anticyclone, becoming an east to south-east wind. Beyond 30° W. the pressure distribution and the corresponding air trajectories were variable, but at times the air curved round to become a south-west current and completed the circuit of the anticyclone. This air was now relatively warm, and it became occluded soon after completing the circuit, but some of it reached Scotland about April 20th to 21st, 25th and 27th, before being finally occluded.

The cirrus cloud motion over England was from west to north-west on 17th and 18th, but afterwards was north to north-east. The vertical extent of the anticyclone thereby indicated was typical, but this does not imply that the anticyclone can be explained by the persistence of a definite mass of cold air in the stratosphere. We have seen that in the lower troposphere, where the pressure distribution varied rather less than it did high up, judging from the cirrus motion, the air was very largely renewed four times. When an anticyclone is rejuvenated without the prior existence of a complete new centre, the renewal of the air is associated with the subsidence and lateral divergence of the new cold air, involving a component of wind across the isobars, with some ascent of the warmed air of the old anticyclone, and with associated irregularities in the isobaric distribution. Corresponding developments in the upper troposphere would be convergence over subsiding air, divergence over ascending air, and irregularities of the isobars. Such processes could renew the air high up as readily as the complementary processes undoubtedly do low down. If the air movements in question vanish at some level in the stratosphere, it only means that the layer in question is inactive. It is just as logical to regard pressure changes high up as due to air movements underneath as to take the opposite view. In all probability the persistent feature is a system of organisation of air movement, rather than any one mass of air.

Stratospheric theories fail to account for the fact that persistent anticyclones are very limited in their geographical distribution. The region off our west and north-west coasts is a favourite one both for stationary depressions and anticyclones. Probably the weak gradient of sea temperature is an important feature. There is also a seasonal influence, persistent anticyclones off our north-west coasts being most frequent in spring. Considering the conditions in February, 1932,[1] and also the low continental temperatures in April, 1938, the explanation can hardly be continental heating. A possible reason is the plentiful supply of cold air at that season,

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[1] See *Meteorological Magazine* 67, 1932, p. 29.

and the poor supply of warm air, owing to the low sea temperature. The effect of sea temperature on an anticyclone is most likely to be indirect, the direct influence being the deepening of depressions. When active depressions are at all frequent the anticyclone tends to be kept well to southwards, and may even be absent over the greater part of the Atlantic. Once an anticyclone is established, a breakdown of vertical stability is very unlikely, even if the sea temperature is high, since subsidence exerts a very powerful stabilising influence. Even over land in mid-summer, thunderstorms in anticyclones only develop over high ground, or where a pool of warm air has formed a shallow depression within the high pressure area, with local convergence instead of divergence.

C. K. M. DOUGLAS.

The Horsey Floods of February, 1938

Current and wind at the time as observed aboard certain Lightvessels

BY J. N. CARRUTHERS, D.SC., F.INST.P. (Fisheries Laboratory, Lowestoft).

On the evening of Saturday, February 12th, 1938, the sea burst over the low-lying coastland between Winterton and Palling in Norfolk and flooded an area of farms and marshes given in one estimate as about 15 square miles. Full accounts of the damage done at various places are of course readily accessible in the newspapers of the time.

On Sunday, April 3rd of this year, the sea broke through defences which had been recently constructed at Horsey, and swirled inland far enough to menace the edges of the remaining sandhills.

In view of these events considerable interest attaches to the contemporaneous records of current and wind from a number of lightvessels which are filed at the Lowestoft Fisheries Laboratory. With the permission of the Elder Brethren of Trinity House, and for application to problems of fishery research, continuous observations upon the water-flow past various English lightships are made on behalf of the Ministry of Agriculture and Fisheries by the officers and crew. The observers employ a very robust current-measuring instrument specially designed in Lowestoft for the purpose, and they need never stop observing however bad the weather or silty the water. At the time of the Horsey flooding, one of the instruments in question was in use from each of the six following lightvessels :—

(1) The Cromer Knoll lightship moored at a point about 20 miles north of Cromer.

(2) The Galloper lightship lying 25 miles off Orford Ness in a direction approximately south-east.

(3) The Sandettié lightvessel situated 18 miles east of Deal and 16 miles north of Calais.

(4) The Maas lightship lying about 8½ miles off the Hook of Holland in a direction about north-west.

(5) The Horns Rev lightvessel moored 25 miles west of Blaavand Point (Jutland) in the latitude of the Farn Islands.

(6) The Royal Sovereign lightship about 7½ miles off Beachy Head and roughly south of Bexhill.

The positions of the lightvessels can be seen from the accompanying small chart.

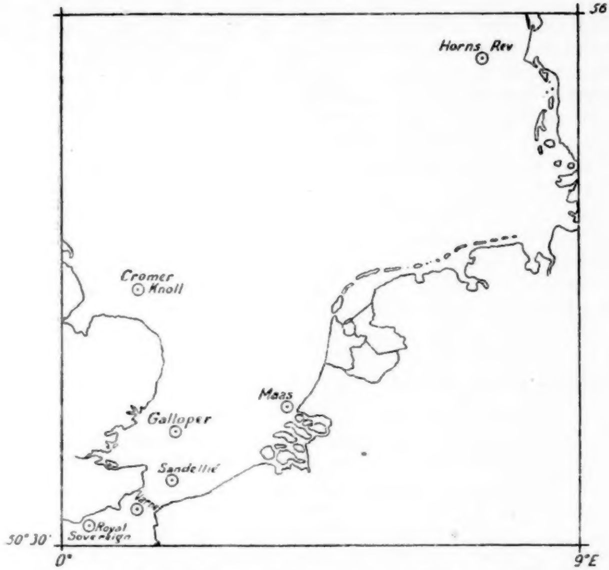

Fig. 1.—Chart Showing the Positions of the Seven Lightvessels Engaged in Continuous Current Measuring.

At each of the lightships the observing went on without intermission, and in the case of the French vessel the work was done for the Lowestoft Laboratory by arrangement with the Office Scientifique et Technique des Pêches Maritimes. The observations aboard the Dutch lightship were part of a comprehensive scheme recently launched by the Rijkswaterstaat who keep very careful watch upon the vagaries of the currents and the changes in the sands in the interests of their coast. At the Horns Rev lightship a parallel programme to the English one was being carried out by the Danish Marinbiologisk Laboratorium of Charlottenlund. Copies of the Dutch and Danish records were kindly supplied to the writer who here expresses his thanks to Dr. J. van Veen and Dr. Å. V. Tåning, respectively.

At a very important key observing position—the Varne lightvessel which is situated in Dover Straits about half-way between Hythe and Gris Nez—continuous current observations were being made by means of another instrument also designed at and supplied by the Lowestoft Laboratory. The work there had been in train for about 12 years.

Records of Wind Conditions

From the English lightvessels and from the French one also, eight observations of wind *per* day are available ; at the Horns Rev six *per* day were logged, whilst at the Maas lightship, twenty-four observations were recorded each day. Aboard all the ships the wind observations were personal ones, and except at the French vessel strength was estimated according to the Beaufort Scale of ten numbers. At the Sandettié, wind strength was logged according to a scale of six numbers in use by French seamen. In the interests of brevity, vector-averages have been worked out for use here. The wind strengths were converted into miles per hour and dealt with in such a manner as to yield for each day, a figure and direction implying what constant wind would (more or less) have effected the same air transport as did all the varying winds which actually blew. It is best to have wind data in this form when it is intended to consider the inter-relationship between wind and current.

In the case of the Sandettié lightvessel, the wind speeds should not be regarded as comparable with those relating to the other positions. The wind data are set down in Table 1.

TABLE 1—WINDS AT THE VARIOUS LIGHTVESSELS

(The Entries are Vector-Averages as explained in the Text. They are based upon (n) observations and are expressed in miles per hour from a true direction.

Ship.	Thursday, 10.2.38.	Friday, 11.2.38.	Saturday, 12.2.38.	Sunday, 13.2.38.
Cromer Knoll	21·6 N.57° W. (8)	25·6 N.36° W. (8)	32·8 N.38° W. (8)	32·8 N.11° E. (8)
Galloper ...	22·8 N.72° W. (8)	28·6 N.40° W. (8)	32·9 N.40° W. (8)	39·2 N. 3° E. (8)
Sandettié*	25·1 Due W. (8)	42·2 N.37° W. (8)	31·5 N.27° W. (8)	49·0 N.10° E. (8)
Maas ...		34·7 N. 2° W. (24)	24·6 N.25° W. (24)	
Horns Rev		37·9 N.20° W. (6)	11·2 N.22° E. (6)	
Varne ...	17·7 N.87°W. (8)	22·6 N. 8° W. (8)	25·8 N.32° W. (8)	33·8 N.26° W. (8)
Royal Sovereign	19·3 S.88° W. (8)	17·2 N. 3° E. (8)	27·6 N.27° W. (8)	33·6 N.34° E. (8)

* See Reservation in Text.

The Flooding

As is quite well known, the flooding was due to a pronounced and wind-induced deepening of the waters of the southern North Sea at a time when the tide would have been high if not affected meteorologically. An already high water-level was markedly raised by strong winds from the NW. quadrant. Relief from such a pooling-up (if the wind remains strong and in the NW.) can apparently come only from an escape of water through the Straits of Dover down Channel, and it is known that there is usually a flow of water *from* the English Channel into the North Sea as attested by the long series of records already referred to.

The writer's justification for concerning himself with this question of flooding is that he has data which show what was happening to the tidal streams at the time, over a considerable area. It is thought that there can never before have been available information of the kind set down below concerning the actual water movements in the open sea at a time when the waters of the Southern Bight were being markedly deepened as the result of wind influence. It is a feature of the instrument which provided our data that its showings are just as acceptable under the very rough sea conditions which prevailed on February 12th, 1938 as they are at times of calm weather.

Although it is horizontal water movements which are our concern here, some remarks upon the deepening with which the profoundly modified tidal streams were associated are necessary to convey an impression of its scale.

It is to be borne in mind that the Horsey flooding took place about 48 hours before full moon, and that the highest predicted water-level was not due until the night tide of Wednesday, February 16th—that is, until the eighth high tide following. The prediction for Dover (read from the "Admiralty Tide Tables") for the high water of Saturday night, February 12th, was 17·2 ft, whereas that for midnight on the following Wednesday was 20·0 ft. It is very fortunate therefore that the north-westerly gale, which was responsible for the flooding, died away when it did.

A glance at the right-hand column of Table 1 will show that on Sunday, February 13th, the winds were predominantly from east of north. Actually they had veered from north-west in the evening of Saturday according to the Cromer Knoll records, and after staying a few hours in the north had further veered to north-north-east. In this quarter they stayed over Sunday. For the next three days the wind was mostly easterly, and it stayed between east and north-east until Monday, February 21st.

We may mention a few details regarding the water deepening due to the north-westerly gale. The night tide of the critical Saturday reached a level at Dover just over 5 ft. in excess of prediction, and the preceding low tide stood at about 2 ft. above predicted level. At Southend the excess was nearly 6 ft. for the night high-water

and very nearly 2½ ft. for the preceding low-water. The high-water crest at Southend was even an inch or so above that of January 6th/7th, 1928. Across at the Hook of Holland, the midnight high tide of Saturday, February 12th had stood at a level 6½ ft. above prediction, and the preceding second low-water (3 hours earlier) had stood at 2 ft. 9 in. above. The excesses for the preceding intermediate high, first low, and high waters, were 4 ft. 6 in., 1 ft. 9 in., and 5 ft. 9 in., respectively. At Harwich the night high and afternoon low tides of Saturday, February 12th, were respectively 5·3 ft. and 2·1 ft. above prediction—the corresponding figures for Sheerness being 6·6 ft. and 2·1 ft.

The Water Movements

The water movements past the various lightvessels were first worked up into the form of overall set, but it has been thought preferable to restrict attention here to tidal streamings for the good reason that comparison can then be more effectively made with well-based means. Also, the modifications brought about by the meteorological conditions can be more easily appreciated.

All that is necessary here is brief comment on Table 2 wherein the relevant data are set down.

The entries for Cromer Knoll and Galloper in Table 2 show quite impressively how the waters of the North Sea were being urged to the southward down the coast of East Anglia. At the Sandettié, instead of a water transport towards north-east at the rate of some 1½ miles a day, there was a transport in the opposite direction approaching 15½ miles a day in amount. At the Maas, the usual north-easterly flow of about 1¾ miles a day on the average had given place to a reversed flow of about 7 miles a day. Even at the Horns Rev the usual NNW.-going flow had been stopped and was soon succeeded by a flow towards the opposite direction.

These facts betoken an enormous urge of water into the Straits of Dover.

At the Varne lightship there was no record of current relating to the day of chief interest only; there the flow is measured at the depth of six fathoms* and we have a record for a four-day period centred at 2045 on February 11th. During that time the flow was 7·9 sea-miles a day towards S. 47° W. true. Over the previous four days it had been towards N. 24° E. and at the rate of 6·4 sea-miles a day. It is clear therefore that the pooling-up of the Southern Bight was being relieved by an escape of water into the Channel at a considerable rate, and some idea of the extent of this can be gained from the fact that the flow at the Royal Sovereign was reversed at the time. In the absence of the information from the Horns Rev lightvessel, one might have supposed that the situation could have

* At the Maas lightship the observations were made at a depth of about 4½ fathoms, and at the other lightvessels the measurements were made at about 1½ fathoms depth.

TABLE 2—SHOWING (UNDER A AND B) THE DAILY RUN IN SEA-MILES OF THE FLOOD AND EBB STREAMS AT THE VARIOUS LIGHTVESSELS AT THE TIME OF THE HORSEY FLOODING OF FEBRUARY, 1938 (NUMERATORS) COMPARED WITH AVERAGE VALUES (DENOMINATORS) AND (UNDER C), THE CORRESPONDING EXCESSES. EACH UPPER ENTRY REFERS TO THE ONE DAY INDICATED. THIS, WITH ITS CENTRAL TIME IS SHOWN BENEATH THE FIRST OF THE "FRACTIONS."

Ship.	A {Flood Streams towards	B {Ebb Streams towards	C {Excess towards	Basis of Means used for Comparison.	Remarks as to Preceding and/or Following Day or Days.
Cromer Knoll ...	SE. 11·3 / 10·4 12.2.38—1515	NW. 6·5 / 9·9	SE. 4·8 / SE. 0·5	Average for the Whole Year 1937.	
Galloper	SW. 14·8 / 12·3 12.2.38—0645	NE. 10·6 / 11·0	SW. 4·2 / SW. 1·3	Average for the last three Entire Winters.	*Preceding Day*— SW. excess was 9·8 miles. *Following Day*— SW. excess was 12·1 miles.
Sandettié ...	NE. 4·9 / 13·2 12.2.38—2345	SW. 20·3 / 11·6	SW. 15·4 / NE. 1·6	Average for the last three Entire Winters.	
Maas	N.71° E. 6·6* / N.52° E. 9·8 12.2.38	S.50° W. 13·6* / S.58° W. 8·1	*ca.* SW. 7·0* / *ca.* NE.'E. 1·7	Average for period July, 1937, to February, 1938, inclusive.	*Preceding Day*— Flood *ca.* 1·1 miles.† Ebb *ca.* 13·1 miles.† Excess—about 12 miles towards SW. approx.
Horns Rev ...	NNW. 5·0 / 7·6 12.2.38—0955	SSE. 4·9 / 4·2	NNW. 0·1‡ / NNW. 3·4	Average for Winter 1937/38 = Dec., 1937 + Jan., 1938 + Feb., 1938.	*Following 3 days*— SSE. excess was 3·7, 5·0, and 6·8 miles respectively.
Royal Sovereign	E. 6·8 / 9·6 12.2.38—0845	SW. 9·2 / 8·0	SW. 2·4 / E. 1·6	Average for the Whole Year 1937.	*Preceding Day*— SW. excess was 3·1 miles. *Following Day*— SW. excess was 6·5 miles.

* The observing technique is somewhat different at this ship. These values were obtained by vector-averaging 22 equally-spaced observations of current within the day.

† These values were obtained on vector-averaging 23 equally-spaced observations of current made on February 11th. The flood stream ran mainly towards a N. by E.'ly point and the ebb towards a WSW.'ly point.

‡ The least amount of drift at this vessel during the whole Winter.

been somewhat relieved by a strengthening of the usual north-going flow up the east side of the southern North Sea. Actually, the flow was to the southward there for some days afterwards.

The fact that such a reversal of flow in the eastern Channel as occurred at the critical time in February 1938, persisted on such a scale as it did on the following days, must, with the disappearance of north-westerly winds over the North Sea, have relieved the situation quickly. Had the winds stayed in the north-west and remained strong, there must have occurred still more disastrous flooding in Norfolk. That such would have been the case seems certain because there were still more than a dozen higher tides to be expected. If therefore, at high tide time a few days later, there had been a *sudden* increase in strength of an already strong wind which had been blowing persistently from the danger quarter, very much more serious trouble on the Norfolk coast would clearly have been inevitable. The quick surge which would have resulted, would have met with greater resistance than a few days earlier, so that, where the North Sea starts to narrow, deplorable consequences would have ensued.

A few words on the events of Sunday, April 3rd and succeeding days—though lightvessel records of current and wind are not available at the time of writing.* Here the break-through occurred at the time of highest expected tide. It came at the time of a tide which, judging from Dover predictions ("Admiralty Tide Tables"), was due to be 2 ft. higher than that of Saturday, February 12th. In the case of the later flooding the following tides were due to be less and less, and it would seem therefore that the associated wind conditions must have been much less potentially dangerous than in February.

Acknowledgments

For information as to actual heights of tide I am indebted to the following :—

The Hydrographic Department of the Admiralty—in the cases of Harwich and Sheerness.

Commander E. C. Shankland, R.N.R., F.R.S.E., River Superintendent, Port of London—in the case of Southend.

Mr. G. Sutton, Superintendent of Works to the Dover Harbour Board.

Dr. J. van Veen of the Rijkswaterstaat at the Hague.

Appendix

Since the above was written, records have been received from the Royal Sovereign lightship which show that during the day centred at 0925 on Sunday, April 3rd, there was an ebb (towards SW.) excess of $2\frac{1}{3}$ miles — whereas the previous day had witnessed a flood (towards E.) excess of $5\frac{1}{3}$ miles.

At the Varne lightvessel, a 2-day record centred at 1030 on Sunday,

* But see Appendix.

April 3rd, shows a residual flow of 5·0 miles a day towards S. 30° W. Here the preceding and following days were both days of flow towards the most usual (NE.-going) direction.

A record from the Cromer Knoll lightship, which refers to the day centred at 0715 on Sunday, April 3rd, bears witness to a flow of 4⅛ miles towards SE. The preceding day had also been a day of SE.-going flow (2⅜ miles) but, on the following day, there was hardly any overall water movement whatsoever.

OFFICIAL PUBLICATIONS

AVERAGES OF HUMIDITY FOR THE BRITISH ISLES (M.O. 421)

This publication, which is a companion volume to Averages of Temperature (M.O. 407) and Averages of Sunshine (M.O. 408) contains monthly and annual averages of temperature, atmospheric vapour pressure and moisture content at midday (13h. G.M.T.) for 44 well-distributed stations, together with averages of relative humidity in the morning (7h.) at midday (13h.) and in the evening (18h.). Supplementary tables contain hourly averages of relative humidity and vapour pressure at selected stations. The geographical distribution of average relative humidity and vapour pressure at midday is shown by a series of twenty-six charts, covering the twelve months and the year as a whole. In an Appendix the standard values of saturation vapour pressure and the moisture content of saturated vapour are given for all temperatures from 0° F. to 120° F.

The volume thus contains much data of a kind required for engineering, industrial, medical and meteorological purposes, which has not hitherto been available in summarised form.

PROFESSIONAL NOTES

No. 80. *A height-computer for use in aerological work.* By E. G. Bilham, B.Sc., D.I.C. (M.O. 336t).

The paper describes the theory and construction of a mechanical device for determining the height of an aircraft from observations of pressure and temperature. Two forms of the instrument are described, a simple form for computation of heights up to 24,000 ft., and a more elaborate form for greater heights.

Royal Meteorological Society

The usual monthly meeting of the Society was held on April 27th, in the Society's rooms at 49, Cromwell Road, South Kensington. Dr. B. A. Keen, F.R.S., President, was in the Chair.

The following papers were read and discussed :—

A. B. Tinn.—Local temperature variations in the Nottingham district.

The author has found that considerable variations occur in the Nottingham district, though the topography offers no unusual features. An area of relatively high land, with irregular spurs,

stretches north-north-east from Nottingham Castle. The monthly values of three stations for the nine years 1928–1936, and those of five other stations for shorter periods, are analysed. It is found that local differences of 10° F. in the minima may occur, and the mean monthly minima may differ by over 4° F. Although fine weather, a rising barometer, and a low humidity favour large variations, it appears that conditions producing low minima do not always give appreciable differences. Rainy, windy conditions bring the differences to a minimum. Differences of 6° F. in the maxima may occur on certain warm, sunny days in summer, and variations of 8° F. in foggy conditions. Topographical features give Attenborough the most "continental" temperatures.

E. W. Hewson, M.A., Ph.D. (Beit Scientific Research Fellow).—The application of wet-bulb potential temperature to air mass analysis, IV.

This paper describes :—(*a*) The moisture content of subsiding polar continental air over North America, under conditions when there was no likelihood of an increase in the moisture content due to precipitation from overrunning air. Two situations of this type are discussed, and no evidence is found of any appreciable increase above 850 mb. ; (*b*) the degree of homogeneity in polar continental air masses. The vertical distributions of wet-bulb potential temperature as observed nearly simultaneously at adjacent stations within an air mass are discussed in relation to their effect on the accuracy of computations of subsidence ; (*c*) the vertical velocity of air in the warm sector of a depression. It is shown that in the warm sector considered, the ascent of the air near the surface was nearly twice as rapid as that at about 600 mb. The vertical velocity of the surface air was of the order of 4 cm./sec. and that of the air at about 600 mb. was of the order of 2 cm./sec. ; (*d*) the effect of turbulence in the air near the surface. The changes of temperature and moisture content in the surface layers of a moving air mass are discussed in the light of the theory of turbulence, as developed by Richardson and Taylor.

D. Lloyd, M.Eng.—Evaporation over catchment areas.

The paper examines the variation in the annual total loss over eight drainage-areas by a statistical method. It is postulated that loss is a joint function of meteorological elements and the geological formation penetrated by any rain water ; further, that in the present stage the joint functional causation can be simplified to one of separate tunctions. Thus, it is assumed that the variations in loss can be associated with the rainfall, providing the opportunity for evaporation, the temperature, the sunshine experienced, and, as, following the primary loss in the zone of aeration, influent seepage may provide a flow in the zone of saturation which later may provide a deferred opportunity for evaporation from the capillary fringe and effluent seepage from ground-water, with the geological formation.

Regressions of loss on the available postulated controls have been inferred. By inductive reasoning, an equation is found approximately representing the observations over the eight areas, by which the annual loss expected on account of various influences can be estimated.

A meeting of the Society was held on Wednesday, May 4th, in the Society's rooms at 49, Cromwell Road, South Kensington. Dr. F. J. W. Whipple, F.Inst. P., Vice-President, was in the Chair, and Major H. C. Gunton, M.B.E., F.R.Ent. Soc., presented the Phenological Report for 1937.

Correspondence

To the Editor, *Meteorological Magazine*

Dust Haze in the Upper Air

At 1130 G.M.T. on October 19th, 1937, the western horizon became very hazy and by 1200 G.M.T. the haze had spread eastwards across the sky up to an angle of about 30°. During the next hour the sky became completely covered with this thin layer of dust haze. The first impression was that the haze sheet resembled a smoke haze similar to that experienced near industrial areas in the British Isles. Smoke however being more or less non-existent in this part of the world, the haze must have been due to suspended dust particles. It was very difficult to estimate the height and depth of the layer but upper winds during the forenoon of the 19th showed that up to 8,000 feet the wind was from 180° to 210° ; above that height the direction was from about 230° to 250° which is approximately the direction from which the haze appeared to be travelling. The sky was free from cloud during the period and the haze gradually disappeared towards evening.

Duststorms, associated with the circulation round the Cretian Low, were reported from the western desert on the previous days, and there seems little doubt that the dust then raised was carried along at a height somewhere in the neighbourhood of 8,000 to 12,000 feet. Warm air arrived in this area about 0600 G.M.T. on the 19th, and in the late afternoon medium and high cloud spread from west-south-west.

It would be of interest to know if this phenomenon was experienced by other stations. F. Davies.

Meteorological Office, Ramleh, Palestine, October 22nd, 1937.

On investigation it appears that on October 18th a well-marked cold front west of Sollum at 0600 G.M.T. was associated with a squally dust-raising wind from west, force 5. The dust was apparently carried along by the general SW. wind then prevailing over the Middle East Area. The distance from Sollum to Ramleh is about 650–700 miles and at 7,000 to 10,000 feet wind was 220° to 240°, 20–30 m.p.h., so that the dust haze should have arrived at Ramleh about 30 hours after 0600 G.M.T. on October 18th, which is exactly what happened. C. W. Lamb.

St. Elmo's Fire in Egypt

In view of Mr. Sutton's note in the March issue of the *Meteorological Magazine* the following extract from " A Search in Secret Egypt " by Paul Brunton (Rider & Co. 1936) may be of interest. A footnote to page 77 reads :*—

" Dr. Abbate Pacha, Vice-President of the Institut Egyptien spent a night in the desert near the Pyramids, together with Mr. William Groff a member of the Institut. In the official report of their experiences the latter said : ' Towards eight o'clock in the evening, I noticed a light which appeared to turn slowly around the Third Pyramid almost up to the apex ; it was like a small flame. The light made three circuits round the Pyramid and then disappeared. For a good part of the night I attentively watched the Pyramid ; towards eleven o'clock I again noticed the same light, but this time it was of a bluish colour ; it mounted slowly almost in a straight line and arrived at a certain height above the Pyramid's summit and then disappeared.' "

The account goes on to say that Mr. Groff found that this phenomenon was well-known to the Arabs who put it down to spirits. Unfortunately the weather conditions do not appear in the excerpt as cited. CICELY M. BOTLEY.

Guildables, 17, Holmesdale Gardens, Hastings, March 18th, 1938.

Persistent Fog

Referring to the article on "Persistent Fog" by Lt.-Col. E. Gold which appeared in the March, 1938 issue of the *Meteorological Magazine*, it might interest readers to learn that fog has been very prevalent this winter around Woodside Park, North London. This place lies between Barnet on the north, Mill Hill on the west and Golders Green on the south, and through this district from Barnet to Golders Green runs the Dollis Brook. The district is fairly open and there are a good many fields still left untouched by builders. On several occasions the mornings here have been very foggy but on approaching London by train via Highgate and Finsbury Park there has been an absence of fog or only a very faint mist after leaving Highgate for Finsbury Park. It has been noticed on occasions when the City of London has been free from fog, fog has persisted all day at Woodside Park. I am inclined to think that the prevalence of fog is mainly due to the expanse of grassland together with perhaps the valley of the Dollis Brook acting as good ground for radiation on calm, clear nights. In the more densely populated areas towards the City of London the surface of the ground is kept appreciably warmer by centrally heated buildings thus preventing to a certain extent the lowering of the temperature taking place by radiation at night and preventing the formation of fog. It would be interesting to know whether other open spots around cities have experienced similar conditions. J. MONGER

Woodside Park, N.12, March 28th, 1938.

*We are indebted to Messrs. Rider & Co. for permission to reproduce this extract.

A Duststorm in 1836

As a result of the account of a dust devil at Haditha which appeared in the *Meteorological Magazine* for September 1937, my attention has been directed to a storm which, in the same district, wrecked the steamer "Tigris" on the river Euphrates in 1836. It may be recalled that in 1835 an expedition left England under the command of Colonel Chesney to test the navigability of the river Euphrates. The material for two iron steamers was transferred by sea to the bay of Antioch and thence across the desert to the Euphrates—a most difficult and trying undertaking.

The expedition began to move down the Euphrates in March 1836 and on May 21st had reached a point near Anah. The following account of the storm which overtook the expedition at this point is taken from Ainsworth's "Personal account of the Euphrates expedition" published in 1888.

"The wind was blowing gently from the south-east or up the river and against us but only sufficiently so as to ripple the water.

"After proceeding a short distance a dark mass of cloud was observed in the horizon to the west-south-west but as the sky had been much overcast in that direction for several days the appearance was not at first considered to be important. The cloud however continued to advance rapidly towards us, and it was seen to cling to the land or as it were to breast the surface of the desert. The awnings of both vessels were immediately furled, anchors were got in readiness, and all preparations for meeting what was evidently a portentous storm.

"As the cloud neared us, the sky assumed an appearance such as we had never before witnessed, and which was awful and terrific in the extreme. A dense black arch enveloped the whole of the horizon and the space beneath the arch was filled up with a body of dust, of a brownish orange colour, whirling round, and at the same time advancing towards us with fearful rapidity.

"At this moment the hurricane came on us—a warm dry wind, laden with the fragrance of the aromatic plants of the wilderness, with some rain in large drops. The crash broke upon us like heaven's own artillery, and the hurricane seemed as if bent upon hurling both steamers at once to the bottom of the foaming river.

"The wind in the meantime was tearing the boards from off the paddle boxes like shreds of paper and the waves rising to a height of 4 or 5 feet dashed in through the windows.

"All at once she sank casting 34 brave men upon the flood to struggle against a furious wind and a strong current with an atmosphere so charged with dust and spray that it was almost as dark as night.

"These hurricanes appear to be peculiar to great level tracts and desert spaces, from their being exposed to changes which acting upon an extensive uniform surface, unbroken by forests or mountains,

accumulate with an intensity that causes them to burst over some fated spot with fearful energy and destructiveness. For the same reason, they only last a brief time, discharging almost at once their pent-up electric tension, and at the same time re-establishing an equilibrium of elasticity and pressure with the atmosphere around.

"The almost resistless impetuosity of the storms, and their whirling character, not only cause them to tear up the plants and shrubs of the wilderness, but they even carry sheep off their legs if taken unawares. These animals however, generally meet the hurricane with their legs drawn up and their noses to the ground.

"The Arabs, if on horseback, bid their steeds lie on the ground and they themselves seek shelter by the side of their bellies; or if on foot, they lie close to the ground during the prevalence of the blast, which they call by various names, as fatulah, and samm, whence our simoon.

"Amminus relates, in his account of Julian's descent of the river in boats, that when he was at Anatho (Anah), there occurred a terrible event; whirlwinds which blew down the houses and tents, overthrew the soldiers, and caused many boats to sink.

"Josephus writes, upon more questionable authority, that of a Sibyl, that it was by a similar phenomenon, viz. that of an impetuous wind or violent hurricane, that the tower of Babel was thrown to the ground."

Modern meteorologists will recognise in the above description many features which would now be attributed to the passage of a cold front—the sharp line of the base, the black arch of cloud enveloping the whole horizon, with the space beneath the arch filled with dust—the short duration of the storm and the sudden clearance. Such storms are common in Iraq during April and May and of course they occur frequently in the Sudan during the summer months. In Iraq the rotatory character of the storm is as a rule not marked but this feature of the Sudan haboob is always stressed.

It would of course be impossible for the average sand devil such as occurred at Haditha to cause the loss of the river steamer although no doubt many of the more restricted squalls and haboobs are sand devils on a large scale.

J. DURWARD.

Airport, Baghdad, December 15th, 1937.

Parhelion and Sun-Pillar

Last evening, April 18th, at Trefnant, Denbighshire, at 18h. 14m. a brilliantly prismatic parhelion of the halo of 22° was seen with part of the parhelic circle. After this, part of the halo itself became visible, and a faint sun-pillar; also the upper arc of contact of 22° which slowly changed its shape as the sun's elevation diminished.

S. E. ASHMORE

Llannerch Gardens, St. Asaph, Flintshire, April 19th, 1938.

REVIEWS

Climate and Birth

A well known rhyme asks: "What is it moulds the life of man?" and answers emphatically: "The weather!". Dr. Ellsworth Huntington, in a series of important works, has traced this dominant influence from the cradle to the grave; he has now, in a book* which has attracted a great deal of attention, carried his researches back to the moment of conception and beyond, and proved that climate is of even greater importance in these early stages than later in life.

He starts by showing that in a normal temperate climate the number of births is greatest in late winter and early spring. In a savage community living in a rigorous environment the children born in spring have the greatest chance of survival, a chance which is still further increased if the parents are at their best physically at the time of conception and most active mentally when the child is new-born. Hence modern man has inherited from his savage forebears of the Ice Age two optima of temperature; his body works best at a temperature of about 63° F., characteristic of summer, and his mind at about 47° F., characteristic of spring. As a result, children tend to be conceived most readily in summer, to be born in the following spring. Social conditions, such as the periodical absence of the young men from home, may cause minor irregularities, but the underlying basic rhythm shows clearly in nearly all the curves.

As one travels from sub-arctic to sub-tropical latitudes, summer comes earlier, and so also does the maximum birth-rate, which is displaced to January in southern Spain. Within the tropics the cool season is the more favourable and conceptions are most numerous when the temperature falls to about 65° F. after the rains, when conditions are otherwise favourable.

Not only are births in temperate regions more numerous in early spring, but their quality also appears to be higher. The children born at this season tend to live longer, and to produce more eminent men and women in proportion to their numbers than those born at other seasons. Huntington has collected an immense amount of material in support of the latter conclusion, which is of considerable social importance, and some curious by-products emerge. One is that the optimum temperatures for both the conception and birth of eminent persons are appreciably lower than for the common herd. Still stranger are the curious relations between the sex ratio (i.e., the number of boys born per 100 girls) and climatic differences, both from month to month and place to place. A remarkable series of maps shows that in the U.S.A. and Europe the sex ratio is smallest in regions where the climate is most favourable for efficient work.

* Season of birth: its relation to human abilities. New York (John Wiley & Sons, Inc., 1938, pp. VII + 473. 3.50 dollars net.)

Huntington accounts for this by an interesting physiological theory, which is directly connected with his main thesis.

All these remarkable facts give a definite clue to the climate in which modern man—*Homo sapiens*—evolved. After making allowance for the lowering of temperature during the Ice Age, our cradle is most probably located on the Iranian plateau, a finding which agrees with the results of archaeological research. They also lead to some far-reaching suggestions for the future, to give as many children as possible the advantage of being born in the right season for the climate.

C. E. P. Brooks

The Régime of the Rivers Euphrates and Tigris. By M. G. Ionides, B.A. (Oxon), Assoc.M.Inst.C.E., M.Inst.W.E. Crown quarto, 284 pp., *Illus.* E. & F. Spon, London, 1937. Price 32*s.* net.

Mr. Ionides has performed for the basin of the Twin Rivers much the same valuable service that has been done for the Nile by Col. Sir Henry Lyons[1], Sir William Willcocks[2] and Drs. H. E. Hurst and P. Phillips[3]. Would that British engineers further east might be inspired to tell us in equally lucid yet compact form something of the hydrology of such important river-basins as those of the Indus, Ganges, Brahmaputra and Murray !

The Euphrates and Tigris drain portions of four countries, Turkey, Syria, Iran (Persia) and Iraq (Mesopotamia). The lattermost, in which the author has worked, is half as large again as the British Isles together and its Administration has to deal with the problems of both excessive river-floods and shortages of irrigation-supplies.

The author first describes the methods of surface-water measurement used in Iraq and the modes in which the data thus obtained are treated statistically. He then discusses the climate of the basin, in the study of whose rainfall and other features Turks with German training and Syrians under French guidance have hitherto apparently been able to help more than the Iranians, whose deficiencies Mr. Ionides has tried to make good. By utilising a formula derived from the observations of annual rainfall and run-off in the basins of the Euphrates and of the Tigris above Mosul, he has been able to make an approximate computation of the average annual rainfall over the remaining catchment areas, and even to produce a conjectural rainfall map for the whole area.

Four chapters describe the physical features and irrigation works of the two river-systems and supply numerous statistical and graphical details of their water-levels and discharges. Three very interesting chapters discuss (i) river-bed instability, silting and scouring ; (ii) the forecasting of winter and summer discharges and levels ; and (iii) the

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[1] "The Physiography of the River Nile and its Basin." Cairo, 1906.

[2] "Egyptian Irrigation," 3rd Edn. 2 vols., Spon. London, 1913.

[3] "The Nile Basin," 4 vols., Government Press. Cairo, 1931-35.

extreme floods to be expected and their respective probabilities of occurrence.

To those concerned with the study of a river-system and the interpretation of its hydrological records, in whatever country they may be, the book should form a most useful guide or example. To those in Great Britain in particular it may moreover serve in conjunction with our own observations and other cognate overseas works in our own tongue to reveal natural facts and laws of world-wide instead of merely local application.

Since Mr. Ionides is now serving in Transjordan, it is to be hoped that a further contribution to this end will eventually be received from him, surveying the last remaining of the great Biblical rivers

> " From Paneas the fount of Jordans flood
> To Bëersaba, where the Holy Land
> Borders on Aegypt and the Arabian shoare."

W. Allard

BOOKS RECEIVED

Onweders, optische verschijnselen, enz. in Nederland. Naar vrijwillige waarnemingen in 1934. Deel LV, Utrecht, 1936.

Cycles in tree-ring widths. By C. G. Abbot. Smithson. misc. Coll., Vol. 95, No. 19, Washington, D.C., 1936.

The Cyclone season 1933–34 at Mauritius. By N. R. McCurdy, B.Sc., Mauritius, Misc. Publ. R. Alfred Obs., No. 16, 1936.

Summary of the meteorological observations made at the meteorological stations in the Netherlands West Indies during the year 1936, compiled by the Royal Netherlands Meteorological Institute. The Hague, 1937.

Annual Report, The Climate of Palestine during the year 5696 (1935–6) and Table of Rainfall in the upper Euphrates, Syria, Lebanon, Palestine, the Sinai Peninsula and lower Egypt during the winter 5696 (1935–6). By Dr. D. Ashbel of the Hebrew University, Jerusalem, Tel-Aviv, 1937.

The Cyclone Season 1934–35 *at Mauritius.* By M. Herchenroder, B.Sc., F.R.A.S., Mauritius: Royal Alfred Observatory, Misc. Pubs. No. 17. Port Louis, 1936.

Report of the Observatory Committee to the Royal Cornwall Polytechnic Society and the Falmouth Town Council for the year 1937. Falmouth, 1938.

La distribution de la pluie des Golfes d'Egine et de Nauplie et les iles de l'Archipel du Sud. By Dr. Ath. Th. Kephalas. Athens, 1937.

A Theoretical Note on the Diurnal Variation of Wind-Vector due to the Variation of Eddy-Viscosity. By Tadao Namekawa and Tatutosi Takahasi. (Rep. Kyoto. Imp. Univ. Mem. Coll. Sc. Ser. A. Vol. XXI, No. 1, 1938.)

OBITUARY

Nicolas Sama Perez.—We have learnt with regret of the death on January 1st last of M. Sama, Director of the Spanish Meteorological Service and a member of the International Meteorological Committee. Born in 1877, M. Sama entered the service of the Central Meteorological Institute immediately after completing his education at Madrid. He became Director of the present Service, evolved by his own efforts from the nucleus of the Institute, in 1932. M. Sama was especially attracted to weather forecasting, and personally drew up the daily weather charts during a period of nearly forty years. Handicapped in recent years by ill health, he found it impossible to continue his duties under the intensive conditions of the war, and he was allowed by the Republican Government, in view of his 42 years of official service, to retire to the village of Anglesola, in the Province of Lérida, while maintaining his rank as Director of the Service. He died at Anglesola on January 1st, 1938.

Erratum.

April, 1938, p. 73, line 33, *for* " 35 m.p.h." *read* " 15 m.p.h."

The Weather of April, 1938

An intense anticyclone was centred over the British Isles, where pressure exceeded 1025 mb. in Great Britain and 1029 mb. in Ireland. Pressure decreased rapidly towards depressions over Baffin Bay in the north-west and the White Sea and Novaya Zemlya in the north-east; eastwards a ridge of high pressure (above 1015 mb.) extended across Europe to the Black Sea. Another anti-cyclone lay over Persia and the Caucasus. Pressure was also high over north-eastern Siberia. No data were received for North America. In the centre of the anticyclone over Ireland and western Britain pressure was more than 15 mb. above normal, but the Azores showed a deficit of 6 mb. and the Arctic regions were also below normal, by more than 10 mb. in northern Russia.

Temperatures differed little from normal over the British Isles, but most of Europe was abnormally cold, Switzerland and Austria having mean temperatures of only 40–45° F., more than 5° F. below normal. The Arctic regions on the other hand were generally warm, the excess being more than 5° F. from Cape Chelyuskin to north-east Greenland, and reaching 8° F. at Spitsbergen and 9° F. at Dickson. Most of Siberia was also 5 to 10° F. above normal. Rainfall was deficient over the whole of Europe and many parts, including Ireland, England and France received less than 0·5 in.

The *Weekly Weather and Crop Bulletin,* published by the U.S. Weather Bureau, shows that the beginning of the month was warm on the Atlantic coast and the Lake region but cold in the west. The second week was generally cold but the last half of the month was

everywhere above normal. Rainfall did not differ greatly from the average.

No reports were received this month from Australia and New Zealand.

In the British Isles the weather of April was distinguished by an exceptional deficiency of rainfall.* Over the country generally it was by far the driest April on record. At numerous stations in Ireland and at some in south Wales and south-west England no measurable rain fell throughout the month. Sunshine was excessive on the whole except at some stations in the eastern districts of Great Britain and the extreme north of Scotland. The excess was unusual in the west ; at a number of stations it was the sunniest April on record and at Valentia Observatory 262 hours is the largest total for April in a record which started in 1880. Mean temperature for the month exceeded the average in Scotland and slightly exceeded the average in Ireland and north-east England but was appreciably below the average in east and south-east England.

During the opening days a depression moved north-east from the Atlantic to the south of Iceland and then eastward to the Baltic. Gales were reported in Scotland on the 2nd and 3rd and rain occurred at times, chiefly in the northern half of the country, though rain was also experienced at most places in the south on the 2nd. The rainfall was moderately heavy locally in the north and north-west ; 1·17 in. was measured at New Dungeon Ghyll and 1·28 in. at Upper Teesdale, Westmorland, on the 2nd. The 3rd was a sunny day but polar air in the rear of the depression caused a considerable fall in temperature on that day. Sleet and snow fell locally in Scotland on the 2nd and 3rd. From the 5th to 7th depressions passed east across Iceland and further local gales were reported in Scotland. Temperature rose again in the north and west on the 5th and in the south on the 6th ; a maximum of 66° F. was registered at Southampton, Scarborough and Oxford on the 6th and at Cardiff and Marlborough on the 7th. On the 7th and 8th the anticyclone off west Ireland moved north and then east over the British Isles and anticyclonic conditions prevailed generally until the 15th. There was practically no rain throughout the country from the 8th to 14th. Among low minimum temperatures registered in the screen during this period were 20° F. at Dalwhinnie on the 9th, 21° F. at Eskdalemuir on the 10th and 20° F. at South Farnborough and 21° F. at Marlborough on the 11th. Subsequently the anticyclone became centred off the north-west of Ireland while pressure was low over Scandinavia and during the Easter holiday cold winds prevailed with local showers of hail, sleet and snow, though it continued dry and sunny in many parts particularly in the west. Sharp frosts occurred in some localities ; a screen minimum of 20° F. was registered at Barton, Manchester, and 21° F. at Burnley and Rhayader on the 18th and 20° F. at Droitwich and Rhayader on the 19th. Thereafter the anticyclone remained over or to westward of Ireland.

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* See page 81.

There was a good deal of cloud in many parts and slight rain occurred locally at times in eastern England and Scotland, and more generally in England on the 22nd and 23rd, but the weather continued mainly dry and rather sunny over most of Ireland. A thunderstorm, accompanied by hail, occurred at Tunbridge Wells on the 25th. A trough of low pressure crossed Scotland on the 27th and caused some rain, mainly in the northern half of the country, and from the 28th to 30th the anticyclone moved north-east to the north of Scotland while a depression moved north-south-east from Jan Mayn to Germany. Local rain occurred in the eastern districts of England on the 29th and in south-east England on the 30th also. Sunshine records were good on the whole on the last three days particularly in the north and west; 14·5 hours were registered at Tiree on both the 29th and 30th and 14·4 hours at Oban on the 30th. The distribution of bright sunshine for the month was as follows:—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway ..	140	−10	Chester ..	189	+50
Aberdeen ..	121	−23	Ross-on-Wye	218	+76
Dublin	208	+49	Falmouth ..	240	+53
Birr Castle ..	229	+77	Gorleston ..	145	−19
Valentia ..	262	+101	Kew.. ..	150	+ 4

Kew, Temperature, Mean, 46·3, Diff. from average −1·4.

Miscellaneous notes on weather abroad from various sources.

After the drought which has held since the beginning of March in the Swiss canton of Ticino, many hundreds of acres of woodland were destroyed by fire in the early days of April. A hurricane off the coast of Norway caused damage to shipping, and four skiers lost their lives in a blizzard on the Norwegian mountains on the 3rd. Gales were also reported from the Riviera. A severe cold wave swept over southern Europe from the 10th until the end of the month. Snow appeared on Vesuvius on the 10th, and heavy falls occurred in Switzerland and the Italian Alps on the 19th and 21st. The sudden intense cold and frost caused widespread damage to vineyards and fruit crops in France, Switzerland and Italy, the total loss being estimated at approximately £18,000,000. (*The Times*, April 5th–26th.)

A dense sandstorm delayed all shipping in the Suez Canal on the 16th. (*The Times*, April 18th.)

Drought extended over most of Australia from the beginning of the month, but was broken by violent storms accompanied by hail in southern Australia and Victoria on the 16th–18th. Aurora was observed in Wellington, N.Z., on the 16th. Floods, reported to be the most severe in the history of the Province, occurred at Hawkes Bay, New Zealand, on the 27th. (*The Times*, April 6th–27th.)

Snow fell heavily in New York and the northern United States on the 6th. Telephone wires were broken down by blizzards in

Nebraska and Iowa, and many roads were blocked by drifts. In a tornado in Alabama, ten people were killed and 200 rendered homeless, and 12 persons were drowned in floods following a cloudburst in Georgia, Alabama and Mississippi. Central Canada experienced a severe blizzard on the 10th. Temperatures rose rapidly in New York to the 15th when 81°F. was recorded, 32°F. above normal; and on the 28th when a further record of 84°F. was attained. (*The Times*, April 7th–29th.)

Severe gales were experienced in the North Atlantic on the 9th–11th. (*The Times*, April 12th.)

Daily Readings at Kew Observatory, April, 1938

Date	Pressure, M.S.L. 13h.	Wind, Dir., Force 13h.	Temp. Min.	Temp. Max.	Rel. Hum. 13h.	Rain.	Sun.	Remarks
	mb.		°F.	°F.	%	in.	hrs.	
1	1027·6	W.3	46	63	62	—	6·8	
2	19·1	WSW.5	43	56	62	—	5·1	r_0 24h.
3	21·4	NW.5	41	52	34	0·06	10·9	r_0–r 0h.–1h. and 2h–3h.
4	30·2	WNW.2	34	52	39	—	6·3	x early.
5	23·8	SW.3	34	52	70	—	0·0	x early, ir_0 13h.–14h.
6	25·4	WNW.3	45	62	60	—	7·0	w early.
7	24·6	NW.3	41	61	50	—	8·2	
8	27·9	NNE.3	40	51	48	—	9·1	
9	32·3	NNE.4	35	47	53	—	0·6	x early.
10	40·4	ESE.3	36	51	42	—	8·4	
11	40·9	N.3	30	55	47	—	10·5	x early, m till 8h.
12	36·1	NE.4	33	60	47	—	8·7	mx till 8h.
13	28·7	NNE.3	36	59	48	—	11·0	mx till 8h.
14	25·3	NNE.4	41	55	53	—	1·8	
15	25·5	NE.4	40	54	60	—	2·1	
16	24·2	E.2	37	57	54	—	7·9	x early.
17	29·9	NNE.4	38	49	40	—	5·5	pr_0 9h.
18	31·3	N.4	33	47	50	—	6·3	pr_0 13h.
19	26·7	NNW.3	34	52	43	—	2·4	f late.
20	29·5	NNE.2	35	54	48	—	2·8	fx–m till 10h.
21	28·7	N.2	43	54	46	—	0·6	pr_0 10h.
22	20·9	NNW.4	44	54	55	—	0·7	pr_0 12h. and 14h.
23	19·9	NW.3	41	51	66	—	0·0	x early, r_0 7h.
24	23·4	N.2	42	52	72	0·02	0·5	r_0 4h–5h., r 7h.
25	21·4	NNE.3	46	54	75	—	0·8	r_0 13h. and 17h–18h.
26	21·3	ENE.3	36	53	70	—	2·0	x early, g 15h.
27	19·4	NNE.2	41	56	67	0·01	2·0	m 7h., r_0 12h–13h.
28	20·0	NE.3	38	56	48	—	5·2	r_0 13h. and 17h.
29	19·6	NNE.4	37	51	44	—	8·1	pr_0 17h.
30	1015·4	NNE.5	36	54	43	—	8·7	pr_0 18h., r_0 21h.
*	1026·0	—	39	54	53	0·09	5·0	* Means or totals.

General Rainfall for April, 1938

England and Wales	13	per cent of the average 1881–1915.
Scotland	34	
Ireland	7	
British Isles ...	17	

Rainfall: April, 1938: England and Wales

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Lond .	Camden Square..........	·10	6	*Leics* .	Thornton Reservoir ...	·05	3
Sur .	Reigate, Wray Pk. Rd..	·11	7	,, .	Belvoir Castle............	·03	2
Kent .	Tenterden, Ashenden...	·71	44	*Rut* .	Ridlington	·07	4
,, .	Folkestone, Boro. San.	·93	...	*Lincs* .	Boston, Skirbeck.........	·19	14
,, .	Margate, Cliftonville....	·67	50	,, .	Cranwell Aerodrome...	·16	12
,, .	Eden'bdg., Falconhurst	·36	19	,, .	Skegness, Marine Gdns.	·20	15
Sus .	Compton, Compton Ho.	·07	3	,, .	Louth, Westgate.........	·25	15
,, .	Patching Farm...........	·22	13	,, .	Brigg, Wrawby St.......	·12	...
,, .	Eastbourne, Wil. Sq....	·59	32	*Notts* .	Mansfield, Carr Bank...	·09	5
Hants.	Ventnor, Roy.Nat.Hos.	·03	2	*Derby*.	Derby, The Arboretum	·12	7
,, .	Southampton,East Park	·03	2	,, .	Buxton, Terrace Slopes	·52	18
,, .	Ovington Rectory.......	·03	2	*Ches* .	Bidston Obsy.............	·22	13
,, .	Sherborne St. John......	·07	4	*Lancs*.	Manchester, Whit. Pk.	·31	16
Herts .	Royston, Therfield Rec.	·28	18	,, .	Stonyhurst College......	1·25	46
Bucks.	Slough, Upton............	·10	7	,, .	Southport, Bedford Pk.	·20	11
Oxf .	Oxford, Radcliffe.........	·10	6	,, .	Ulverston, Poaka Beck	·52	17
N'hant	Wellingboro, Swanspool	·07	5	,, .	Lancaster, Greg Obsy.	·47	21
,, .	Oundle	·07	...	,, .	Blackpool	·24	13
Beds .	Woburn, Exptl. Farm...	·12	8	*Yorks*.	Wath-upon-Dearne......	·14	9
Cam .	Cambridge, Bot. Gdns.	·17	13	,, .	Wakefield,Clarence Pk.	·08	5
,, .	March........................	·50	38	,, .	Oughtershaw Hall.......	1·14	...
Essex .	Chelmsford,County Gdns	·28	22	,, .	Wetherby, Ribston H..	·05	3
,, .	Lexden Hill House......	·34	...	,, .	Hull, Pearson Park......	·31	20
Suff .	Haughley House..........	·36	...	,, .	Holme-on-Spalding......	·14	8
,, .	Rendlesham Hall........	·47	33	,, .	Felixkirk, Mt. St. John.	·28	17
,, .	Lowestoft Sec. School...	·82	55	,, .	York, Museum Gdns....	·10	6
,, .	Bury St. Ed., WestleyH.	·54	35	,, .	Pickering, Houndgate...	·21	13
Norf. .	Wells, Holkham Hall...	·26	20	,, .	Scarborough...............	·26	17
Wilts .	Porton, W.D. Exp'l. Stn	·03	2	,, .	Middlesbrough............	·11	8
,, .	Bishops Cannings........	·22	11	,, .	Baldersdale, Hury Res.	·60	25
Dor .	Weymouth, Westham.	·11	7	*Durh* .	Ushaw College............	·09	5
,, .	Beaminster, East St....	·19	8	*Nor* .	Newcastle, Leazes Pk...	·13	8
,, .	Shaftesbury,Abbey Ho.	·03	1	,, .	Bellingham, Highgreen	·31	14
Devon.	Plymouth, The Hoe....	·19	8	,, .	Lilburn Tower Gdns....	·41	21
,, .	Holne, Church Pk. Cott.	·22	6	*Cumb*.	Carlisle, Scaleby Hall...	·56	29
,, .	Teignmouth, Den Gdns.	·09	4	,, .	Borrowdale, Seathwaite	2·00	29
,, .	Cullompton	·22	10	,, .	Thirlmere, Dale Head H.	1·14	24
,, .	Sidmouth, U.D.C.........	·04	...	,, .	Keswick, High Hill......	·53	17
,, .	Barnstaple, N. Dev.Ath	·13	6	,, .	Ravenglass, The Grove	·25	10
,, .	Dartm'r,Cranmere Pool	·80	...	*West* .	Appleby, Castle Bank...	·24	12
,, .	Okehampton, Uplands.	...	...	*Mon* .	Abergavenny, Larchf'd	·04	2
Corn .	Redruth, Trewirgie......	·02	1	*Glam* .	Ystalyfera, Wern Ho....	·41	11
,, .	Penzance, Morrab Gdns.	·03	1	,, .	Treherbert, Tynywaun.	·53	...
,, .	St. Austell, Trevarna...	·10	4	,, .	Cardiff, Penylan..........	·17	7
Soms .	Chewton Mendip.........	·26	9	*Carm* .	Carmarthen,M. & P. Sch.	·05	2
,, .	Long Ashton..............	·25	11	*Pemb* .	Pembroke,Stackpole Ct.	·00	0
,, .	Street, Millfield...........	·05	3	*Card* .	Aberystwyth	·32	...
Glos .	Blockley	·11	...	*Rad* .	BirmW.W.Tyrmynydd	·57	15
,, .	Cirencester, Gwynfa....	·11	6	*Mont* .	Newtown, Penarth Weir	...	...
Here .	Ross-on-Wye..............	·06	3	,, .	Lake Vyrnwy	·30	10
Salop .	Church Stretton.........	·21	10	*Flint* .	Sealand Aerodrome......	·20	14
,, .	Shifnal, Hatton Grange	·13	8	*Mer* .	Blaenau Festiniog	1·03	18
,, .	Cheswardine Hall.......	·09	5	,, .	Dolgelley, Bontddu......	1·10	30
Worc .	Malvern, Free Library...	·06	3	*Carn* .	Llandudno	·28	17
,, .	Ombersley, Holt Lock.	·04	3	,, .	Snowdon, L. Llydaw 9..	2·20	...
War .	Alcester, Ragley Hall...	·13	8	*Ang* .	Holyhead, Salt Island...	·21	10
,, .	Birminghm, Edgbaston	·10	6	,, .	Lligwy	·37	...

Rainfall: April, 1938: Scotland and Ireland

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
I. Man	Douglas, Boro' Cem....	·41	17	*R&C* .	Achnashellach	3·23	57
Guern.	St.Peter P't.Grange Rd.	·04	2	„ .	Stornoway,C.GuardStn.	·85	30
Wig .	Pt. William, Monreith.	·26	12	*Suth* .	Lairg..........................	1·69	73
„ .	New Luce School.........	·69	26	„ .	Skerray Borgie............	2·20	...
Kirk .	Dalry, Glendarroch......	·62	20	„ .	Melvich.......................	1·33	57
Dumf.	Dumfries, Crichton R.I.	·29	13	„ .	Loch More, Achfary....	3·87	80
„ .	Eskdalemuir Obs........	·92	27	*Caith* .	Wick...........................	1·56	78
Roxb .	Hawick, Wolfelee........	·17	8	*Ork* .	Deerness	1·44	70
Peeb .	Stobo Castle..............	·36	17	*Shet* .	Lerwick Observatory...	1·56	68
Berw .	Marchmont House......	·38	19	*Cork* .	Cork, University Coll...	·10	4
E.Lot .	North Berwick Res.....	·05	4	„ .	Roches Point, C.G. Stn.	·02	1
Midl .	Edinburgh, Blackfd. H.	·15	10	„ .	Mallow, Longueville....	·06	2
Lan .	Auchtyfardle	·53	...	*Kerry*.	Valentia Observatory...	·09	2
Ayr .	Kilmarnock, Kay Park	·66	...	„ .	Gearhameen...............	·30	5
„ .	Girvan, Pinmore.........	·55	19	„ .	Bally McElligott Rec...	·13	...
„ .	Glen Afton, Ayr San. ...	·83	27	„ .	Darrynane Abbey.......	·05	1
Renf .	Glasgow, Queen's Park	·57	29	*Wat* .	Waterford, Gortmore...	·00	0
„ .	Greenock, Prospect H..	·85	25	*Tip* .	Nenagh, Castle Lough.	·40	16
Bute .	Rothesay, Ardencraig...	·37	12	„ .	Cashel, Ballinamona....	·10	4
„ .	Dougarie Lodge..........	·53	19	*Lim* .	Foynes, Coolnanes......	·22	9
Arg .	Loch Sunart, G'dale....	1·22	29	*Clare* .	Inagh, Mount Callan....	·55	...
„ .	Ardgour House..........	2·45	...	*Wexf* .	Gorey, Courtown Ho...	·03	1
„ .	Glen Etive..................	...	...	*Wick* .	Rathnew, Clonmannon.	·00	...
„ .	Oban........................	1·02	...	*Carl* .	Bagnalstown,Fenagh H.	·06	3
„ .	Poltalloch..................	·72	24	„ .	Hacketstown Rectory...	·09	3
„ .	Inveraray Castle.........	1·98	43	*Leix* .	Blandsfort House.......	·05	2
„ .	Islay, Eallabus...........	·49	17	*Offaly*.	Birr Castle................	·15	7
„ .	Mull, Benmore...........	2·40	31	*Kild* .	Straffan House...........	·11	6
„ .	Tiree	·35	14	*Dublin*	Dublin, Phoenix Park..	·06	3
Kinr .	Loch Leven Sluice.......	·24	13	„ .	Balbriggan, Ardgillan...	...	...
Fife .	Leuchars Aerodrome...	·08	5	*Meath*.	Kells, Headfort..........	·01	0
Perth .	Loch Dhu..................	1·50	32	*W.M* .	Moate, Coolatore........	·11	...
„ .	Crieff, Strathearn Hyd.	·29	13	„ .	Mullingar, Belvedere...	·21	9
„ .	Blair Castle Gardens....	·46	22	*Long* .	Castle Forbes Gdns......	·12	5
Angus.	Kettins School...........	·09	5	*Gal* .	Galway, Grammar Sch.	·21	9
„ .	Pearsie House............	·45	...	„ .	Ballynahinch Castle....	·50	14
„ .	Montrose, Sunnyside...	·34	19	„ .	Ahascragh, Clonbrock.	·10	4
Aber .	Balmoral Castle Gdns..	·40	19	*Rosc* .	Strokestown, C'node.....	·19	9
„ .	Logie Coldstone Sch....	·53	26	*Mayo*.	Blacksod Point..........	·37	13
„ .	Aberdeen Observatory.	·78	42	„ .	Mallaranny	·65	...
„ .	New Deer School House	·69	35	„ .	Westport House.........	·24	9
Moray	Gordon Castle............	·47	27	„ .	Delphi Lodge.............	1·07	19
„ .	Grantown-on-Spey	·75	38	*Sligo* .	Markree Castle...........	·39	15
Nairn.	Nairn	·48	32	*Cavan*.	Crossdoney, Kevit Cas..	·17	...
Inv's .	Ben Alder Lodge.........	1·87	...	*Ferm* .	Crom Castle...............	·15	6
„ .	Kingussie, The Birches.	·59	...	*Arm* .	Armagh Obsy............	·08	4
„ .	Loch Ness, Foyers	·83	38	*Down*.	Fofanny Reservoir.......	·33	...
„ .	Inverness, Culduthel R.	·47	28	„ .	Seaforde	·13	5
„ .	Loch Quoich, Loan......	7·23	...	„ .	Donaghadee, C. G. Stn.	·20	10
„ .	Glenquoich................	5·52	85	*Antr* .	Belfast,Queen's Univ....	·30	13
„ .	Arisaig House............	1·31	37	„ .	Aldergrove Aerodrome.	·24	11
„ .	Glenleven, Corrour......	2·15	53	„ .	Ballymena, Harryville.	·51	19
„ .	Fort William, Glasdrum	1·77	...	*Lon* .	Garvagh, Moneydig....	·25	...
„ .	Skye, Dunvegan.........	1·27	...	„ .	Londonderry, Creggan.	·69	27
„ .	Barra, Skallary..........	·91	...	*Tyr* .	Omagh, Edenfel.........	·38	14
R&C.	Tain, Ardlarach..........	·80	41	*Don* .	Malin Head...............	·52	21
„ .	Ullapool	1·57	51	„	Dunkineely................	·98	...

Climatological Table for the British Empire, November, 1937

STATIONS.	PRESSURE. Mean of Day M.S.L.	PRESSURE. Diff. from Normal.	TEMPERATURE. Absolute. Max.	TEMPERATURE. Absolute. Min.	TEMPERATURE. Mean Values. Max.	TEMPERATURE. Mean Values. Min.	TEMPERATURE. Mean Values. ½ Max. and Min.	TEMPERATURE. Mean Values. Diff. from Normal.	TEMPERATURE. Mean. Wet Bulb.	Relative Humidity.	Mean Cloud Am'nt	PRECIPITATION. Am'nt.	PRECIPITATION. Diff. from Normal.	PRECIPITATION. Days.	BRIGHT SUNSHINE. Hours per day.	BRIGHT SUNSHINE. Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0–10	in.	in.			
London, Kew Obsy.	1017·2	+ 2·6	55	25	46·9	37·2	42·1	− 1·4	39·2	94	8·0	1·38	− 0·84	10	1·5	17
Gibraltar	1017·0	− 1·0	72	53	65·8	57·9	61·9	+ 1·9	57·9	88	6·5	1·82	...	11	...	...
Malta	1015·3	− 0·6	76	53	69·3	60·7	65·0	+ 1·1	63·1	75	5·1	1·78	− 1·79	10	6·8	67
St. Helena	1013·4	− 0·5	68	54	63·0	56·1	59·5	+ 1·0	57·0	95	9·9	0·76	− 0·42	12	...	...
Freetown, Sierra Leone	1011·4	+ 2·2	89	70	86·4	73·4	79·9	...	75·8	80	5·6	2·95	− 2·17	12	...	...
Lagos, Nigeria	1011·1	+ 1·0	92	71	88·6	74·7	81·7	0·0	76·8	87	5·7	0·38	− 2·29	4	8·6	73
Kaduna, Nigeria	1012·8	...	94	53	91·0	58·2	74·6	− 1·6	61·4	64	5·2	0·00	− 0·21	0	9·7	84
Zomba, Nyasaland	1009·4	+ 0·5	95	58	86·2	66·0	76·1	+ 0·5	73·3	83	4·4	4·68	− 0·40	6	...	...
Salisbury, Rhodesia	1009·6	− 0·6	95	56	85·3	60·5	72·9	+ 2·2	60·9	47	3·2	2·83	...	13	9·1	71
Cape Town	1015·8	0·0	92	47	75·9	56·7	66·3	+ 1·9	59·5	72	5·7	1·03	− 0·06	11	...	...
Johannesburg	1010·2	+ 0·4	90	47	81·0	55·6	68·3	+ 4·6	56·2	46	2·5	2·41	− 2·55	9	9·8	73
Mauritius	1015·2	− 0·9	88	64	83·1	68·9	76·0	+ 0·5	71·6	67	5·1	3·59	+ 1·83	17	9·8	75
Calcutta, Alipore Obsy.	1012·7	− 0·6	89	57	84·0	65·1	74·5	+ 1·0	67·1	85	2·0	0·15	− 0·50	1*	...	...
Bombay	1010·4	− 1·6	94	70	91·0	74·0	82·5	+ 1·9	71·5	70	3·0	0·00	− 0·45	0*	...	...
Madras	1010·2	− 1·1	87	69	82·6	72·8	77·7	− 1·2	74·0	87	8·4	24·61	+ 11·00	13*	...	...
Colombo, Ceylon	1009·3	− 0·7	88	73	84·7	74·1	79·4	− 0·6	76·6	81	7·3	18·00	+ 6·24	24	4·7	40
Singapore	1009·1	− 0·3	89	72	85·8	74·9	80·3	− 0·3	77·3	79	7·1	9·00	− 0·91	17	5·3	44
Hongkong	1016·3	− 1·3	84	53	76·5	66·7	71·6	+ 2·0	65·2	71	6·5	1·03	− 0·71	1	6·1	55
Sandakan	1008·4	...	90	73	87·2	75·3	81·3	+ 0·4	77·9	84	7·7	16·23	+ 1·51	19	...	...
Sydney, N.S.W.	1017·3	+ 3·5	93	53	73·4	61·6	67·5	+ 0·5	62·1	65	7·6	3·66	+ 0·81	15	7·1	51
Melbourne	1017·2	+ 2·8	99	44	74·0	54·7	64·3	+ 3·0	57·0	57	7·1	0·40	− 1·83	5	6·6	47
Adelaide	1016·9	+ 1·6	106	45	81·5	58·1	69·8	+ 2·8	59·2	40	4·8	1·39	+ 0·25	9	8·7	63
Perth, W. Australia	1015·1	− 0·3	95	49	77·4	59·0	68·2	+ 2·1	59·6	53	4·7	0·67	− 0·13	7	9·8	71
Coolgardie	1013·7	+ 0·3	97	41	82·0	54·1	68·1	− 2·6	60·3	58	5·0	1·59	+ 1·00	6	...	...
Brisbane	1015·6	+ 1·0	101	58	78·9	64·4	71·7	− 1·8	66·1	69	7·5	7·94	+ 4·21	17	6·1	45
Hobart, Tasmania	1015·1	+ 5·5	98	40	68·3	51·0	59·7	+ 2·5	53·9	56	5·7	0·75	− 1·72	10	7·9	55
Wellington, N.Z.	1014·8	+ 2·7	75	41	64·4	50·0	57·2	+ 0·4	54·8	74	6·1	2·90	− 0·62	9	7·9	55
Suva, Fiji	1012·0	+ 0·9	88	69	83·6	73·3	78·5	+ 1·4	73·3	78	7·6	5·87	− 3·92	19	5·8	45
Apia, Samoa	1009·1	− 0·4	89	70	85·6	74·4	80·0	+ 1·3	75·7	74	4·6	4·56	− 5·27	11	7·5	59
Kingston, Jamaica	1010·4	− 2·0	89	68	85·6	72·2	78·9	− 0·4	71·7	91	7·3	5·39	+ 2·36	15	5·7	50
Grenada, W.I.	1011·0	+ 0·4	89	70	86	73	79·5	0·0	73	74	4	6·89	− 1·57	19	...	...
Toronto	1016·3	− 1·0	59	20	43·9	33·2	38·5	+ 1·5	...	...	6·8	1·80	− 0·83	13	3·0	31
Winnipeg	1017·2	− 0·2	53	−11	29·8	16·4	23·1	+ 1·8	...	...	5·1	0·46	− 0·61	3	2·4	26
St. John, N.B.	1015·3	+ 0·7	53	19	43·6	30·1	36·9	+ 0·2	33·6	82	6·7	3·90	− 0·51	15	3·0	31
Victoria, B.C.	1013·0	− 2·9	59	29	50·0	42·2	46·1	+ 1·6	45·8	93	9·1	4·56	− 0·85	21	1·9	20
Addendum:																
Brisbane—July	1023·8	+ 5·4	77	42	68·2	49·9	59·1	+ 0·6	52·6	70	4·1	1·15	− 1·05	13	6·8	64
October	1015·3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	+ 1·06	8	8·7	[illegible]

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

(41920) Wt. 24/31 1125 5/38 Hw. G.377/6

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

Addendum:																
Brisbane—July	1023·8	+ 5·4	77	42	68·2	49·9	59·1	+ 0·6	52·6	70	4·1	1·15	− 1·05	13	6·8	64
October	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]